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Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000700260133-4

CONTEMPORARY TREATMENT OF BURNS IN USSR

Klinicheskaya Meditsina, No 8
Aug 1956, pp 3-12

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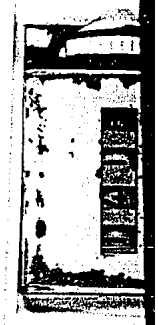
The problem of the treatment of burns, especially third-degree burns accompanied by necrosis of all layers of the skin, is a difficult one. The seriousness of burn injury is determined not only by the degree, i.e., the depth of the affection, but also by its extent on the body surface, the localization, the age of the patient, the general condition at the moment of injury, and the subsequent course of the burn.

An understanding of the essentials of the pathological and physiological processes in burn patients is necessary for successful treatment. Injuries caused by the action of high temperature on an area greater than 10% of the bodily surface are considered serious. They are accompanied by significant changes in the functions of all organs and systems; such changes serve as a basis for speaking of burn sickness.

The course of burn sickness is especially serious in elderly persons. The condition of the heart, the respiratory organs, the liver, and the excretory system are especially important in this case. Even comparatively small burns are poorly borne if accompanied by disturbances in the function of these organs. Patients more than 60 years old suffer from the long period spent in bed; bed sores, pneumonia, and sepsis often result. Children cope with burns somewhat better, but various infective processes and complications of metabolism also develop easily in them. Deep burns of the face, wrists, and genitalia, even when a small area is affected, are in the serious category, inasmuch as their healing is associated with considerable disfigurement and functional disturbances. Especially serious functional disturbances are observed in burns of the joint areas or of their flexural surfaces.

The nature of the thermal agent has great significance. The mildest degrees of burn result from the action of boiling water or hot steam, although the external appearance of the burned surface and the severe pain in the region of the burn sometimes lead to an exaggerated evaluation of the seriousness of the injury. These burns usually heal, by all methods of treatment, within 8-10 days, since only the surface layer of the epidermis is injured. Deeper burns are caused by burning clothing, buildings, or flammable liquids, as gasoline, kerosene, ether, alcohol, which have burst into flame. Especially deep burns are caused by combustible mixtures of the napalm type or mixtures containing phosphorus. The burns resulting from the action of high temperature during the atomic explosion at Hiroshima and Nagasaki were classified as second degree in 90% of the cases and as third degree in only 5% of the cases. This is explained by the fact that the more serious third-degree burns caused by the explosion of the atomic bomb were included with radiation and mechanical injuries. Such cases did not come under medical observation and, therefore, were not taken into account. Burns were observed in 80-85% of those injured by the atomic explosion at Hiroshima and Nagasaki.

Shock may develop in all burn cases with a burn area greater than 10% of the body surface. Shock development in burns is the same as in traumatic shock. A high ambient temperature is an extremely strong stimulant of the receptor apparatus on a large area of the body surface.



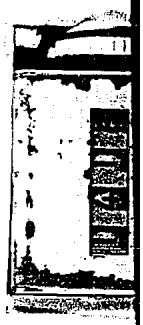
These stimuli are accompanied by a stream of impulses which cause stimulatory and inhibitory phenomena in the central nervous system, leading to exhaustion of the nerve cells and the onset of a state of shock characterized by deep-seated disturbances of the activity of the cardiovascular, respiratory, digestive, and excretory systems.

In the first period of burn shock (the erectile period), a spasm of the vascular vessels and an increase in arterial pressure is observed; this is followed by paralysis of the vasomotors and dilatation of the blood vessels (torpid stage). The fluid part of the blood passes from the vascular stream into the tissues, and edema develops. A sudden drop in arterial pressure is observed in this stage.

Owing to the peculiar nature of burn trauma, shock associated with it is accompanied by loss of plasma; this does not occur in traumatic shock. Normally, the total volume of circulating blood is 8%, and the extracellular fluid is 12%. Plasma loss occurs at the expense of the passage of the fluid part of the circulating blood and depletion of the fluid of the extracellular space. A redistribution of the body fluids occurs in extensive burns as a result of the paralysis of the vasomotors in the burn area. The edema of the tissues in the region of the burn and the plasma loss lead to a sudden depletion of the organism's proteins and electrolytes and to a decrease in the total volume of circulating blood. Plasma loss during shock is sometimes very great. Burned patients lose per day 3-5 liters of edema fluid rich in proteins and electrolytes. The amount of urine discharged drops abruptly. The blood thickens. The erythrocyte count may reach 8 million, and the hemoglobin, 160%. Thinning of the blood occurs within 3 days, and anemia develops as a result of the erythrocyte disturbance. The body loses up to 150 grams of proteins per day with the edema fluid. The average loss of nitrogen in extensive burns is as much as 25.6 grams per day. In addition, hyperglycemia, hyperadrenalinemia, and a reduction in the blood alkali reserve are noted in burn patients.

Casts, proteins, and leached erythrocytes are identified in the urine. The amount of urine secreted decreases suddenly. The seriousness of the patient's condition is determined by the amount of urinary secretion per hour. If less than 50 ml of urine is secreted per hour this is evidence of a disturbance in the filtering function of the kidneys. The hematocrit readings, the level of the blood alkali reserve, and the amount of urinary secretion per hour serve, to a certain extent, as criteria of the seriousness of the circulatory disorders and the disturbance in the secretory function and metabolic processes of the organism.

The pain syndrome, the plasma loss, and the loss of proteins, electrolytes, and fluids are fundamental factors in the pathogenesis of burn shock in the first days of burn sickness. The second or third day after the burn, when the shock symptoms become less prominent, symptoms of toxemia, due to the absorption of the protein-breakdown products of the extensive burned area appear in burn patients. Symptoms of toxemia may also be due to a disturbance in the secretory function of the skin and the poisoning of the organism by products of metabolism which should be secreted through the skin. Toxemia in burns characterized by high temperature, chills, confused mental state, rapid pulse and respiration, low urinary secretion, and gastric symptoms, such as nausea and sometimes vomiting with blood. But it is very difficult to separate toxemia from septicemia, because at this time the infection developing on the burn surface becomes prominent. The high temperature with chills, occasionally hectic fever with a rise in temperature of 2-3°, the suppurative process in the wound, the positive blood cultures, and the high leukocytosis provide a basis for speaking of septicemia in patients with burns covering large areas of the body.



Burns of the upper respiratory passages with subsequent development of edema of the pharynx and trachea and difficulty in breathing may also be observed in facial burns from a hot flame. The course of these burns is often serious or fatal.

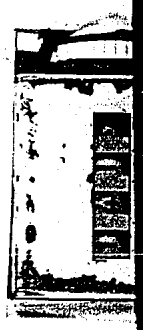
To determine the seriousness of a burn, the percent of the body area burned and the depth of the burn must be known. The area burned is determined most easily from tables prepared by B. N. Postnikov. In these tables is calculated the area of the separate regions of the body and their percentage relationship to the total area of the body.

B. N. Postnikov proposed a simple method for the exact determination of the area of a burn with the aid of a cellophane or washed X-ray film. The film is placed on the burn, and a solution of methylene blue is used to outline its contours. The cellophane is then placed on a centimeter grid by means of which the area of the burn can be calculated. The size of the lesion can also be determined by the rule of "nines," proposed by "Tenison" and "Rulaski." According to this rule, the surface of the head and neck comprises 9% of the total surface of the body; the surface of the upper extremities, 9% each; and the front and back surfaces of the torso and each of the lower extremities, 18% each, for a total of 99%. The genitalia and the perineum occupy the remaining area.

Burns are divided according to depth into three, four, and five degrees. According to the most prevalent classification, the three-degree system, the first degree is characterized by erythema. In this instance, only the epidermis is affected. The pain, which is usually severe at first, subsides rapidly after the application of cold, moist bandages treated with a solution of potassium permanganate, alcohol, and other substances. Healing begins after 2-5 days. Second-degree burns are accompanied by severe hyperemia, the formation of blisters, hyperesthesia, and acute pain. The pain is due to the fact that the nerve endings situated in the papillary layer remain intact. In second-degree burns covering small areas, healing begins after 8-10 days. First- or second-degree burns covering extensive areas may be accompanied by several general reactions, such as shock, plasma loss, and intoxication, if immediate therapeutic measures are not taken. Third-degree burns affect all the layers of skin. The injured area is covered by a thick, white or dark-colored scab. The scab itself on a burned surface is painless, since the nerve endings located in the skin are injured in a deep burn. Charring of the skin and underlying tissues is characteristic of fourth-degree burns.

In extensive burns, it is sometimes difficult to differentiate between second- and third-degree burns during the first few days, since second-degree areas sometimes alternate with third-degree areas. Third-degree burns can be subdivided into three groups which are differentiated from one another by their ensuing course. Thus, in burns affecting the full thickness of the skin, the terminal portions of the sweat and sebaceous glands may survive in the deeper layers. After sloughing of the necrotic layers of the skin, islands of epithelium formed from the remains of these glands appear in the deep granulations. In other cases, the entire thickness of the skin is injured, and independent regeneration of the epithelium from the lower layers cannot occur. Finally, in deeper burns, necrosis of fatty tissue, fascia, muscles, and even of bone, with charring of all the tissues, is also observed.

It is impossible on initial examination in the first days after a burn to differentiate these last three types of burn which differ from each other by depth; therefore, they are combined in a single group of third-degree burns. Nonetheless the division of this group into three separate subgroups is extremely im[illegible] progno[illegible] [illegible]ical measures.



Therefore, the Kraybakh division into five degrees is of great practical value, since a third-degree burn which has not extended through the entire thickness of the skin can end with spontaneous epithelization at the end of the third to fourth week after removal of the scab. Sometimes, on surgical intervention with the scab, viable components of the deeper layers of the skin come off with the necrotic portion. When the wound is infected, portions of a second-degree burn may change to third degree with death of the malpighian layer and the sweat and sebaceous glands. Under these circumstances, closure of the defect with skin transplants may be necessary in a second-degree burn.

Third-degree burns are the most serious, since in their case, even when of comparatively slight extent, serious general symptoms of shock and intoxication may be observed. Complications of infection are added to the serious general symptoms when third-degree burns are extensive.

Treatment

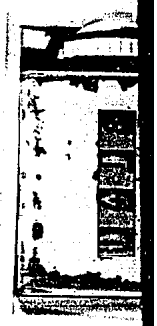
First Aid

In first aid, it is necessary to do the following: (1) close off the burned area from harmful effects of the environment, (2) prevent contamination and infection of the burned surface, and (3) relieve the pain.

To dress a burned surface covering the entire body, it is best to use a sterile sheet; if none are available, a plain, clean, unused one may be used. In burns of separate parts of the body, a large sterile bandage should be used. In the army and in industry, the uncovered parts of the body are the most subject to burns, so bandages prepared in the shape of gloves and masks for use on the face and wrists should be available in special kits. The burn patient should be given 0.01 g of morphine subcutaneously or internally. For additional aid on the scene, there should be syrettes containing morphine and cardiotonic in the kits. After first aid has been given, the injured person should immediately be taken to a hospital, where all necessary therapeutic measures can be taken.

In giving first aid to a great number of burned people, it is necessary to divide them into three groups. In the first group should be the people who have extensive burns, who are in a state of shock, and who have associated injuries. This group of injured should be sent first, and by the most comfortable means of transport (helicopter, airplane, or ambulance) to a special hospital, or a special department of a hospital, for burn patients. In the second group should be the injured with a moderate degree of burn who are in a satisfactory condition. This group may be sent to general surgery hospitals by ambulance or ordinary transport. In the third group are the injured with small areas of burn who are in good condition and who are ambulatory. These people may be sent by truck to a hospital for light injuries.

Burn patients of the first group cannot endure lengthy transportation, since under these conditions they fall into a state of profound shock. If they are given infusions of isotonic saline solutions and blood and plasma expanders en route, even the seriously burned may, according to the evidence of American authors, bear evacuation to a distance of hundreds of miles in the first 24 hours without noticeable harm. To give aid to burn patients during transport, solutions of dextran, glucose, Ringer's solution, and physiological saline solution in previously prepared sterile ampoules and flasks, and sterile sets of needles and tubes should be available. The Americans used for this purpose very convenient plastic bags in which they stored dextran solutions, hydrolyzed serum, and other plasma expanders.



Treatment of Burn Patients in Hospitals

The treatment of burn patients should begin with measures against shock and toxemia. The burned area may be treated only after the hemodynamic disturbances have been corrected. The general treatment of a burn patient must be begun with relief of pain; this is done by subcutaneous injection of morphine. The intravenous injection of morphine, recommended by American and some native authors, results in a lowering of the arterial blood pressure. A remarkable analgesic effect is shown by novocaine block, which may be employed by different methods. In burns of the limbs, an intra-arterial block with a 1% solution of novocaine is most effective.

The following case histories may illustrate the effectiveness of this method.

Patient P., female, age 43, admitted to the clinic on 28 November 1953 with second-degree burns of both shins and feet within 15 minutes after scalding with boiling water. On removal of the stockings, the epidermis peeled off with them along their entire length. The total area of the burn was 2200 sq cm.

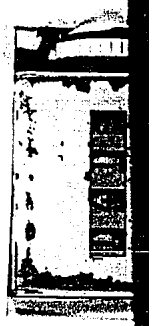
On admission, the patient was moaning with pain. The pulse was 120 beats per minute, and the arterial pressure, 230/120 mm.

Fifteen cc of a 1% solution of novocaine was injected into each femoral artery, after which the pain ceased. Then the surgical preparation of the burn was performed, the peeled-off epidermis was removed, the burned area was washed with saline solution, and a bandage with biomycin compresses, moistened with vaseline oil, was applied to it. After 10 minutes, the arterial pressure dropped to 190/110 mm; at the end of 2 hours, to 150/85 mm; the pulse decreased to 84 beats per minute. The pain did not return. On the 7th day, epithelization was evident on the entire surface of the burn. The patient was discharged in good condition on the 14th day after being burned.

Patient K., male, age 19, admitted to the clinic with second-degree burns of both wrists and the left forearm within an hour after being burned. He had attempted to extinguish a kerosene-type burner which had burst into flame. The total area of the burned skin was 1,745 sq cm (11.6%).

Fifteen cc of a novocaine solution was injected into the left ulnar artery, after which the pain in the left hand subsided. After the burned surface had been prepared, biomycin compresses with vaseline oil were applied. Complete epithelization of the right wrist began on the fifth day, and on the eighth day, epithelization began in the left wrist and forearm. The patient was discharged on the 13th day as fully recovered.

Much experimental work and clinical observation of patients who have received novocaine blocks (B. N. Postnikov, S. P. Protopopov, K. R. Dogayeva, S. I. Itkin, V. M. Osipovskiy, A. S. Korovin, D. N. Fedorov, V. I. Kryazheva, M. A. Sarkisov, G. D. Vilyavin, A. A. Vishnevskiy, A. Ye. Khrushcheva, O. V. Shumova, I. A. Yuchenkova, and others) show that it exerts a normalizing effect on vascular tonus and capillary permeability in burns. The effectiveness of novocaine block was evident not only by cessation of pain, but also by restriction of plasma loss and edema in the area of the burn and by the restoration of arterial pressure. Thickening of the blood and other indexes of hemodynamic disturbances in these patients were less marked than in the patients on whom novocaine block was not used. The authors listed above used a lumbar novocaine block and local injection of novocaine solution in the foci of injury.



On thickening of the blood and decrease in the amount of urine secreted per hour, which in burn patients must be drawn by catheter immediately after delivery to the hospital, plasma expanders and colloidal and saline solutions should immediately be infused.

According to the "Ivens" formula, modified by "Iniat" and Donal'd," a patient with a large burn area should be administered an amount of isotonic saline solution (in cc) equal to the weight of the patient (in kilograms) multiplied by the area of the burn (in square centimeters). In burns covering more than 50% of the body surface, the maximum number, 50, is used. For example, a patient weighing 70 kilograms and having a burn covering 40% of the total area of the body should receive an infusion during the first 24 hours of 70 x 40 = 2,800 cc of saline solution. In addition, he should receive an equal amount of blood and blood expander (dextran) or serum, i.e., 1,400 cc of blood and 1,400 cc of dextran. On the following day, a half dose of these fluids is administered intravenously. The need for colloids and electrolytes, according to American data, is determined by the amount of urine secreted per hour. Infusion of colloidal fluids and isotonic solutions may be stopped if the amount of urine secreted per hour reaches 50 cc. At the end of 48 hours, the administration of saline solutions is stopped, and a solution of glucose is administered to maintain hydration at a normal level. Burn patients should receive periodic transfusions of blood to raise the hemoglobin content to 86% and the erythrocytes to 4,500,000.

Simultaneously with the antishock measures, burn patients should be administered 300,000-500,000 units of penicillin intramuscularly every 6 hours from the very beginning of hospital treatment. If the microflora is insensitive to penicillin, the use of streptomycin, biomycin, or terramycin is recommended. Every burn patient should be administered antitetanus anatoxin and serum.

Local Treatment of Burns

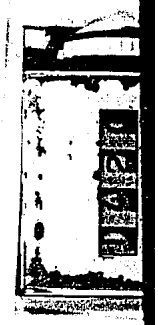
Surgical treatment may be carried out immediately on burns which cover small areas and are not deep. On victims having a large burn area and when there are shock symptoms, general treatment should be carried out, and only after that may surgical treatment be carried out. Most authors admit the possibility of postponing the [surgical] treatment for a day and even longer. [Surgical] treatment of the burned surface should be carried out under aseptic conditions in a clean aid station.

Relief of pain is accomplished by the intravenous administration of a solution of morphine. For painless removal of fragments of epidermis from the wound all manipulations should be carried out with extreme care. The burned area is irrigated with warm saline solution, and the foreign bodies adherent to the wound are removed with a cotton tampon. Unopened blisters are cut at the base and removed. The healthy skin surrounding the burn is washed with alcohol or ether and painted with a solution of brilliant green.

Subsequent treatment of the burn may be by the open or the closed method. Either method of treatment is used in second-degree burns. Equally good results are obtained by both methods, for in burns of the entire thickness of the skin, complications and unfavorable results are possible no matter what method of treatment is used.

Open Method of Treating Burns

After treatment of the burned areas of the skin, the patient is placed on a sterile sheet and covered with a special covering or sterile sheets in the form of a canopy. Sometimes electric bulbs are placed under the covering to warm the patients.



In circular burns, the patient is turned every 6 hours. A scab which protects the wound from infection is formed on the surface of the burn within 48 hours as a result of the drying of the wound exudate. Sometimes, in the area of flexion of a scab, cracks are formed, which, under favorable conditions, dry up, but under unfavorable conditions serve as a point of entry for infection. The scabs on the burn begin to come off at the end of the second and third week; granulation, and sometimes suppuration, occur underneath them. For the most part, the scabs are removed by surgery. After this a bandage with hypertonic solution, sulfanilamide ointment, or Vishnevskiy's ointment is applied to prepare the granulation for grafting. In third-degree burns, the earlier the scabs are removed and the grafting accomplished, the better the results.

The open method of treatment is preferred in pediatrics, in burns of the face and hands, and in burns of one side of the body. The patients prefer the open method because it eliminates the need for the usually painful application of dressing. In the open method, nursing is simplified, and the expense for dressing material is decreased. It is also easier to detect an accumulation of pus under the scabs.

The open method is especially suitable for mass admission of burn patients to rear establishments when the patients do not require further evacuation. When there are large numbers of burn patients, the question of economy of time and dressing material for extensive burns acquires considerable significance.

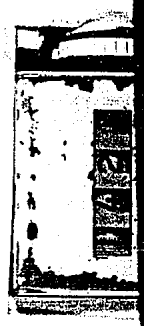
The open method has the advantage over the closed method in that the scab formed on the surface of the burn prevents further exudation of edema fluid and loss of plasma.

The open method also has many disadvantages. It is unsuitable under conditions of treatment by stages, as when the patients have to be evacuated. It is uncomfortable during the winter, when the patients feel cold even in a warm room. During the summer, with the open method the surface of the burn has to be protected from flies, which may deposit maggots on the surface of the wound. Separation of the scab is later than with the closed method. With the open method, hypothermia cannot be used as an antishock measure.

Closed Method of Treating Burns

In the closed method of treatment, sterile compresses moistened with vaseline oil or sulfanilamide emulsion are applied to the burned area after its surgical preparation. A layer of absorbent cotton and a lightly bound bandage is placed over this gauze. When there is much wetting, the bandage has to be changed daily or every second day. After application of the bandage the pain is usually alleviated.

In bandaged second-degree burns, complete epithelization occurs within 8-10 days and the bandage may then be removed. In third-degree burns, the scab is only beginning to peel off from the 10th to the 14th day. Sometimes before this stage, pain appears in the burn area under the bandage, the temperature rises, and the general condition of the patient worsens. This is usually related to an infection of the wound, and such a change for the worse requires surgical intervention, as removal of the bandage and of the scab or making an opening for pus drainage. In the closed method, the scab begins to part from the underlying tissues earlier than in the open method; but infection sets in more often in the moist, warm chamber created under the bandage, complicating the course of the burns and delaying regeneration of epithelium along the margins.



If with the open method of treatment the scab protects the wound from infection, then with the closed method all conditions favoring rapid development of infection are present under the scab. The problem of the surgeon is to remove the scab as soon as possible and to cover the denuded surface with granulation transplants.

The scab begins to part spontaneously along the borders from the 12th to the 14th day, but sometimes it adheres for 3 or 4 weeks. When a large area of the body is deprived of skin, there is danger of septicemia and exhaustion due to loss of protein and the formed elements of the blood. For the successful treatment of burn sickness, it is essential to sue antibiotics to combat infection and to keep track of the qualitative and quantitative composition of the blood, the amount of protein in the blood serum, the hematocrit values, and the urinalyses.

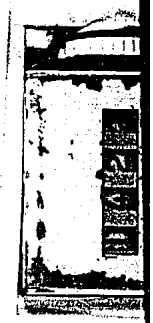
The closed method of treating burns has advantages over the open method during wartime under front-area conditions when evacuation of the burn patients to a more remote area is necessary. The closed method of treatment protects the burn patients from excessive cooling in the winter and from flies in the summer. It is more confortable in circular burns. Besides, it is the only method possible in preparing the granulations for transplants after removal of the scab.

The disadvantages of the closed method are the more frequent onset of infection under the bandage and the need for repeated dressing, which must be done with the use of narcotics. It requires a large amount of dressing material. The application of dressings to one patient with extensive burns requires at least one hour. The servicing of large numbers burn patients by the clost me- presents a difficult problem. Observation of the condition of the burn under the bandage is difficult. Nonetheless, the closed method of treating burns is most suitable in wartime when treating by stages. When suitable conditions are present, the closed method may be replaced by the open method.

Condition of Gastrointestinal Tract in Burn Patients and Their Feeding

Strong thirst is observed in patients in the first hours after a burn. The best remedy for quenching thirst is strong sweet tea, served hot or cold. The great amount of fluid lost by the organism must be replaced to as great an extent possible by an abundance of liquids. During the period of toxemia and hyperpyrexia, burn patients may experience nausea, vomiting, and loss of appetite. Formation of duodenal ulcers, hematemesis, and gastric atonia, with an accumulation of fluid in the stomach, are observed in some patients. Under these conditions, continuous evacuation of the contents of the stomach and washing of the stomach with a sodium carbonate solution through a small stomach catheter are helpful.

Special attention should be paid to the feeding of burn patients, since protein starvation develops because of the significant loss of protein and edema fluid. Therefore, the feeding of burn patients should be under the supervision of an experienced dietician. Every patient should receive daily at least 4,000 calories with his food, containing 200 grams of protein, 100 grams of fat, 500 grams of carbohydrates, and vitamins C, B, and D. The food should be palatable, light, and easily assimilated. Prophylaxis against infection should include early application of a bandage and early initial treatment with mechanical cleansing of the burned area and washing with a soap solution and physiological saline solution. Subsequent drying of the wound in the open method will also prevent the development of infection.



The use of antibiotics, which should begin as early as possible, is of great importance in preventing infection. Penicillin and streptomycin may be injected intramuscularly and intravenously, and biomycin may be administered internally in the usual doses, taking into consideration the type of microflora and its sensitivity to antibiotics. In certain burn patients, when there is a wound infection which is resistant to penicillin and streptomycin, one must resort to other antibiotics, the most effective of which are biomycin, terramycin, and chloromycetin. It is especially difficult to combat infections caused by Bacillus pyocyaneus and Bacillus proteus. American authors recommend strptomycin, polymyxin, tetracycline, and chloromycetin to combat Bacillus pyocyaneus and other types of bacteria insensitive to penicillin and streptomycin.

Local application of antibiotics to a burned area is not justified because it is of no use. Penicillin and streptomycin break down rapidly on the surface of a wound, and the temporary presence of antibiotics in the wound leads to the development of resistant forms of microbes. Biomycin is better because it maintains its activity in a suppurative wound for up to 5 days. Compresses soaked in a solution of biomycin maintain their ability to inhibit the growth of a culture, even after their use on a burned surface for 5 days. However, in third-degree burns no significant effect from the use of such compresses was observed. Therefore, the only mode of action remaining against an infection by antibiotics is by their intrasmuscular, peroral, or intravenous administration.

In burns of an extremity, the intra-arterial method of administration of antibiotics is especially effective and suitable. Daily intra-arterial infusions of penicillin with a 1% solution of novocaine give excellent results, promoting healing and epithelization of the wound.

Operative Closure of Skin Defects After Third-Degree Burns

After a burn, the sooner plastic surgery is performed on the skin, the better are the results. However, the earliest period, according to the view held by many authors, is the period from 8 to 9 days. During this period, the injured person recovers from shock and can stand debridement of the necrotic scab. In an extensive burn, since debridement in itself is a rather traumatic operation accompanied by considerable hemorrhage, most surgeons wait until the scab begins to separate spontaneously. This is usually at the end of the second or the beginning of the third week.

To accelerate the dissolution and separation of the scab, American authors recommend special preparations of the varidase type (steptokinase and streptodoronase), which are extracellular enzymes secreted by special types of hemolytic streptococcus. These enzymes have fibrinolytic and proteolytic properties. Widely advertised in American journals in the proteolytic preparation Tryptar, consisting of the enzyme trypsin in crystallized form, which shows a rapid proteolytic action on a burned area covered with necrotic tissue.

For successful grafts, it is necessary to strive to eliminate hemorrhage, vitreous edema, and necrotic tissues on the granulation area. In external appearance, the granulations should be juicy, clean, granular, and bright red. The presence of microflora on the granulations is not contraindication for transplantation. Attention should be paid to the general condition of the patient. A negative protein balance serves as a contraindication for grafting. Edema in the legs of burn patients is an indication of protein starvation. Under these conditions, repeated blood transfusions, parenteral administration of proteins, and the raising of the protein level to normal are indicated. If the granulations are flabby and hyaloid, they should be irradiated with ultraviolet quartz lamps during the preoperative period.

In extensive burn areas, it is difficult to settle the problem of autoplastic closure of the defect. Autoplastic skin grafting by a dermatome is the best method, but unfortunately it is impractical for circular burns. Under these circumstances the question may arise of closure of a large granulating area with skin taken from relatives of the burn patient or from a cadaver. Homoplastic grafting of skin on burned areas is also possible, and it provides an excellent, although only temporary, effect. The grafted pieces take hold, the general condition of the patient rapidly improves, and near the end of the third week the grafts gradually begin to fuse and to be replaced with epithelium growing from the borders of the defect. Temporary closure of large defects of the skin by homoplastic grafting prevents the loss of plasma and the development of infection, intoxication, and further exhaustion of the patient.

Early skin grafts prevent the formation of disfiguring and function-disturbing scars. The prolonged existence of open granulating wounds following burns leads to formation of scars. The latter are distinguished by heightened sensitivity to trauma and to temperature variations. There are no sweat glands and sebaceous glands in the epithelial covering of the scar; consequently the scars are distinguished by a charachteristic vulnerability and tendency to ulceration. A keloid leading to mechanical constriction of an organ with disturbance of its activity often forms in scars. Therefore, if in the initial stages of burn sickness the physician is faced with the problem of preventing shock, intoxication, infection, and loss of plasma, fluids, and electrolytes, then in the healing stage of the burn the physician should take measures to prevent the formation of scars and to close the defect with normal skin.

To carry out pathogenetic treatment of burn sickness, a complex examination of the patients is necessary by a surgeon, a therapist, a bacteriologist, and a biochemist. A single local influence on a burn wound cannot be wholly successful in extensive and deep burns. General treatment of burn patients should precede local treatment. This not only determines the success of local therapy, but also decides the fate of the victim with extensive injuries.

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